



Organic ice resist lithography with an environmental TEM

Elsukova, Anna; Han, Anpan; Beleggia, Marco

Publication date:
2018

Document Version
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

Citation (APA):
Elsukova, A., Han, A., & Beleggia, M. (2018). Organic ice resist lithography with an environmental TEM. Abstract from 69th Annual Conference of the Nordic Microscopy Society, Kgs. Lyngby, Denmark.

General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.

Organic ice resist lithography with an environmental TEM

Anna Elsukova^{*1}, Anpan Han¹, and Marco Beleggia¹.

¹DTU Danchip/Cen, Technical University of Denmark, 2800 Kongens Lyngby, Denmark.

^{*}E-mail: annaels@dtu.dk

Keywords: Environmental TEM, nanofabrication, lithography, organic ice resists.

In this work we use an environmental transmission electron microscope (ETEM) to investigate the resolution limits of Organic Ice Resist Lithography (OIRL) [1]. OIRL is a novel one-step method for patterning nanostructures. Fig 1(a) outlines the general principle of OIRL. First, the organic vapor condenses into a thin layer of ice on the substrate, which is held at cryogenic temperature. Then, the ice layer is exposed to the scanning electron beam. After beam exposure, the substrate is heated to room temperature and unexposed ice sublimates. The areas exposed to the electron beam are non-volatile and remain on the substrate.

The size of the generated pattern depends on several factors, one being the illumination characteristics. To minimize the instrumental limitation on the patterning resolution imposed by a broad spot, we used the optics offered by an ETTEM operated at 80 kV in scanning mode.

We used simple linear hydrocarbons (N-alkanes) with different molecular weights as precursors. After adjusting deposition and beam exposure parameters, we patterned sub-10 nm features (Fig 1(b)). The experiments revealed that the feature size depends on the precursor molecular weight. Coupling this result with the experimental contrast curves of each precursor (exposed thickness vs. dose) led to a model capable of reproducing the observed line-width vs. molecular weight trends, which is an essential step towards developing an understanding of the physics behind OIRL.

We will also discuss a side-effect observed during our experiments, which could provide a new avenue to study beam-induced charging. Fig 1(c) shows three patterns obtained by scanning the electron beam with different dwell time per pixel. The discontinuities in the patterns are attributed to the sample jumps due to the accumulation and dissipation of charge.

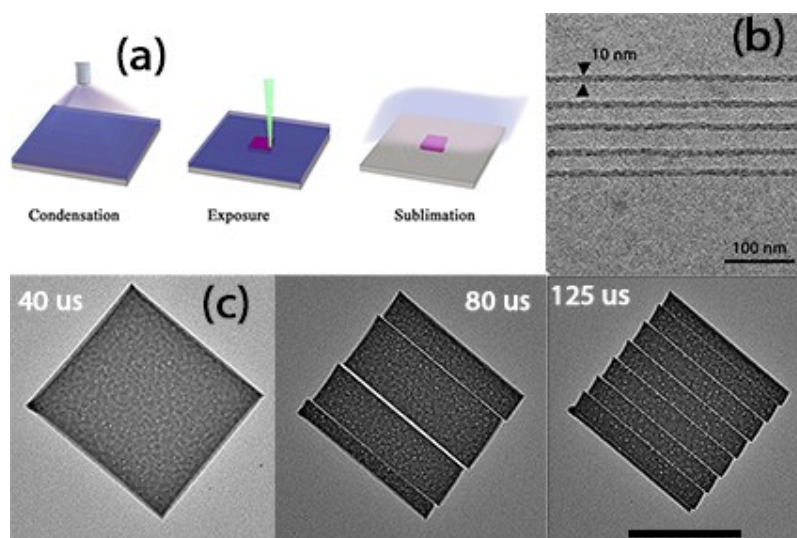


Figure 1(a) General principles of OIRL. (b) Patterned lines on hydrocarbon organic ice. (c) Areas patterned for various beam dwell time per pixel

[1] W. Tiddi, A. Elsukova, H.T. Le, P. Liu, M. Beleggia and A. Han, *Nano Letters* **17**, 7886–7891 (2017).